Digital version

ENGS252 Signals and Systems - Homework 6

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Problem 1

The signal $x(t) = 3\sin(4000\pi t)$, is modulated with carrier signal of 150 MHz frequency. Find the sideband frequencies of the modulated signal.

$$f_{x(t)} = \frac{4000\pi}{2\pi} = 2000Hz$$

The sideband signals are $150MHz \pm 2kHz$

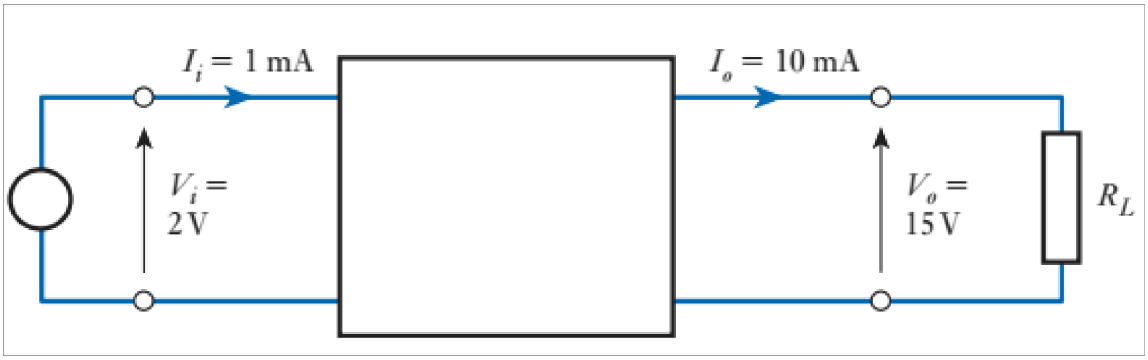
Problem 2

Convert power gains given in dB (20 dB, 30 dB and 40 dB) into numerical value of ratio of power gains and voltage gains. $R_{\text{output}} = R_{\text{input}}$.

dB	B	Power gain	Voltage gain
20	2	10^2	10^1
30	3	10^3	$10^{1.5}$
40	4	10^4	10^2

Problem 3

Determine the voltage gain, current gain and power gain of the following arrangement.



$$\text{Gain}_{\text{voltage}} = \frac{15V}{2V} = 7.5,\ \text{Gain}_{\text{current}} = \frac{10mA}{1mA} = 10,\ \text{Gain}_{\text{power}} = 7.5 \cdot 10 = 75$$

Problem 4

a) Determine the complex impedance of the following arrangements at a frequency of 200 Hz and amplitude of 5 V.

$f = 200Hz,\ \omega = 400\pi$

$$Z_1 = Z_C + Z_R + Z_L = \frac{1}{j\omega C} + R + j\omega L = 80 + j\left(400\pi \cdot 120 \cdot 10^{-3} - \frac{1}{400\pi \cdot 30 \cdot 10^{-6}}\right) \approx 80 + j124.3\ \Omega$$

$$\frac{1}{Z_2} = \frac{1}{Z_C} + \frac{1}{Z_R} = j400\pi \cdot 30 \cdot 10^{-6} + 0.0125 \implies Z_2 = \frac{1}{j400\pi \cdot 30 \cdot 10^{-6} + 0.0125} \approx 7.9 - j23.9\ \Omega$$

b) Find the voltage across the resistor on the left diagram.

$$V_R = V_{\text{in}} \frac{Z_R}{Z_1} = 5 \cdot \frac{80}{80 + j124.3} \approx 1.46 - j2.28\ V$$